Information-Based Improvements on the AIRS Retrievals of Ozone and Methane and Their Validations

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Highlights

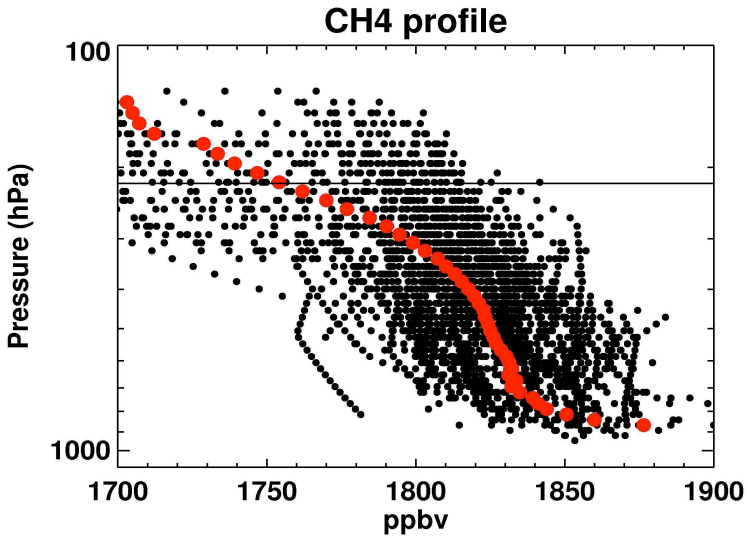
Part I:

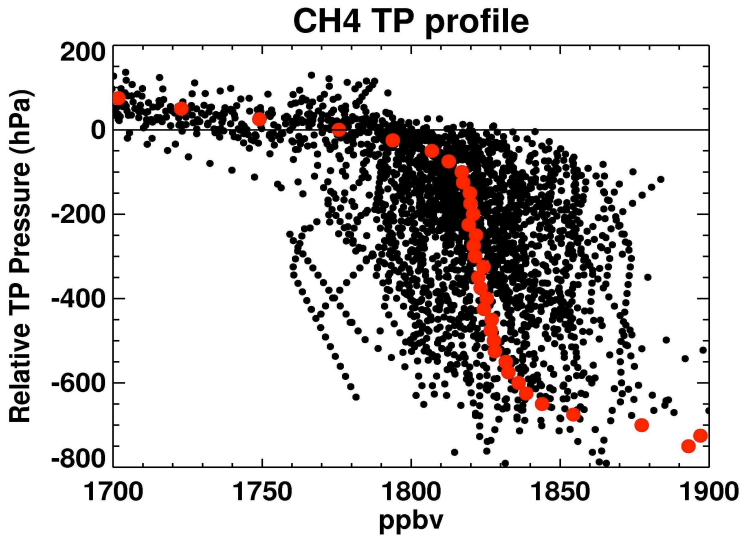
Wei, J. C, L. L. Pan, E. Maddy, J. V. Pittman, M. Divakarla, X. Xiong, and C. Barnet, Ozone Profile Retrieval from Advanced Infrared Sounder: Experiments with Tropopause Based Climatology and Optimal Estimation Approach, submitted to Journal of Atmospheric and Oceanic Technology, 2009.

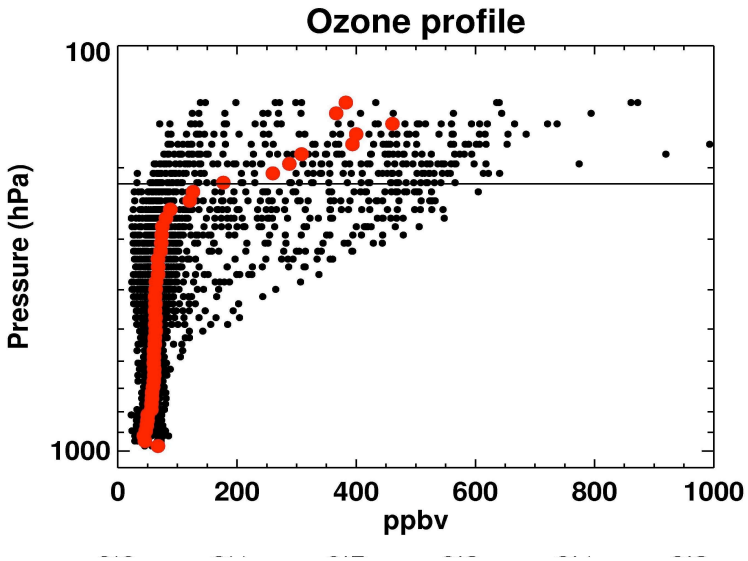
Part II:

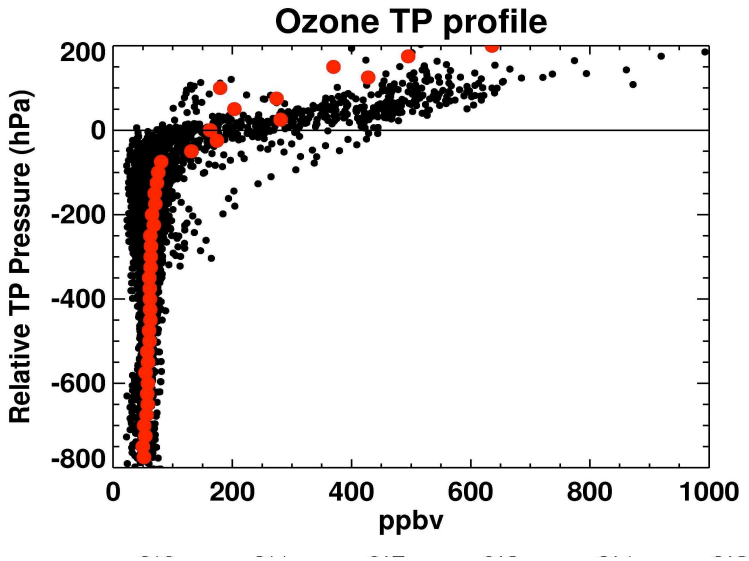
Xiong, X., C. Barnet, J. Wei, and E. Maddy, Information-Based Mid-Upper Tropospheric Methane Derived from Atmospheric Infrared Sounder (AIRS) and Its Validation, Atmospheric Chemistry and Physics Discussions, Volume 9, Issue 4, 2009, pp.16331-16360

Characteristics of Tropopause









Part (I)

Improvement on Ozone Profile Retrieval in the UTLS:

Experiments with Tropopause Based Climatology and Optimal Estimation Approach

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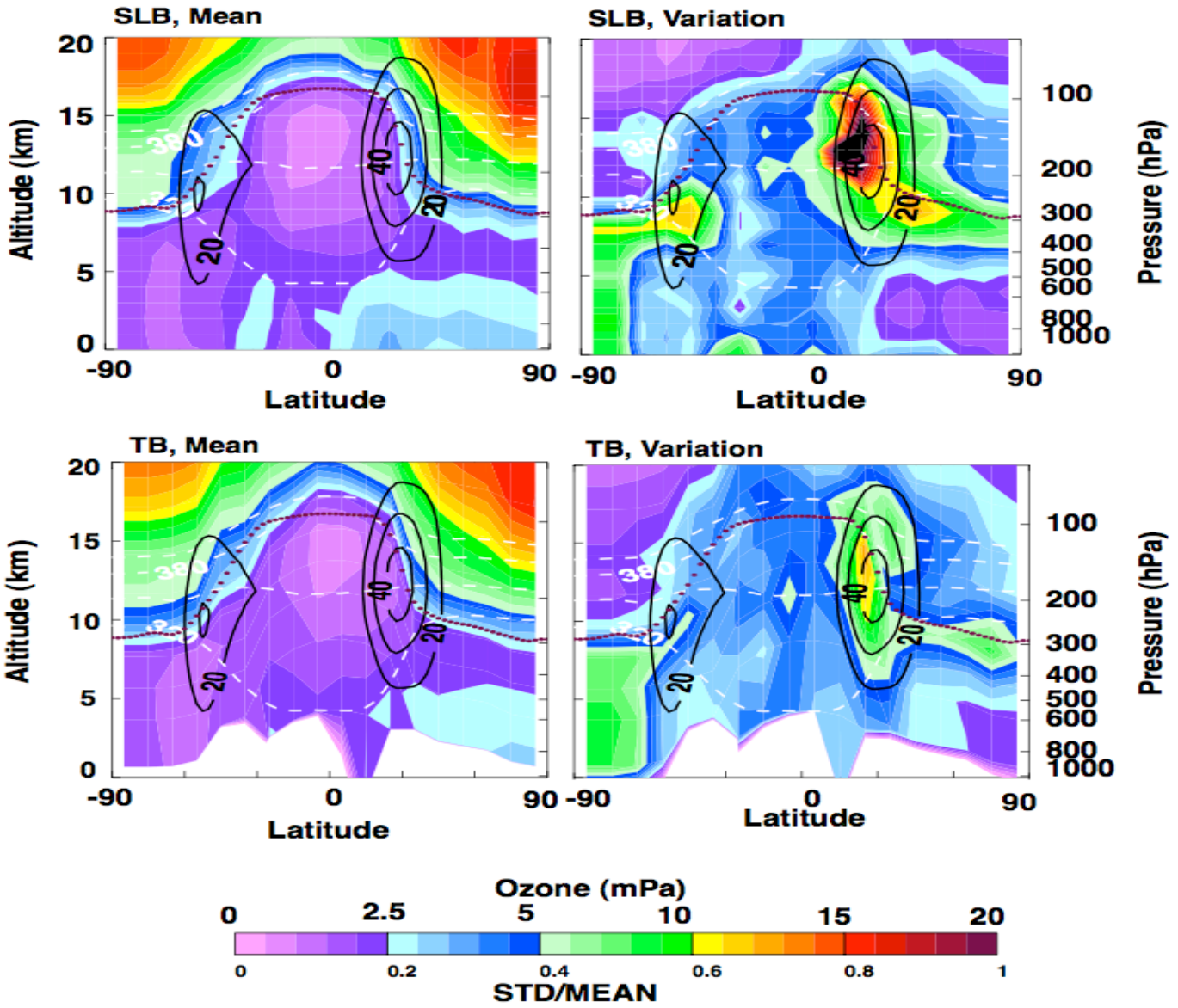
Ozone Mean/Variation in January Using Different Vertical Coordinates

- **SLB:**
  Sea-level based
- **TB:**
  Tropopause based



Retrieval Experiments

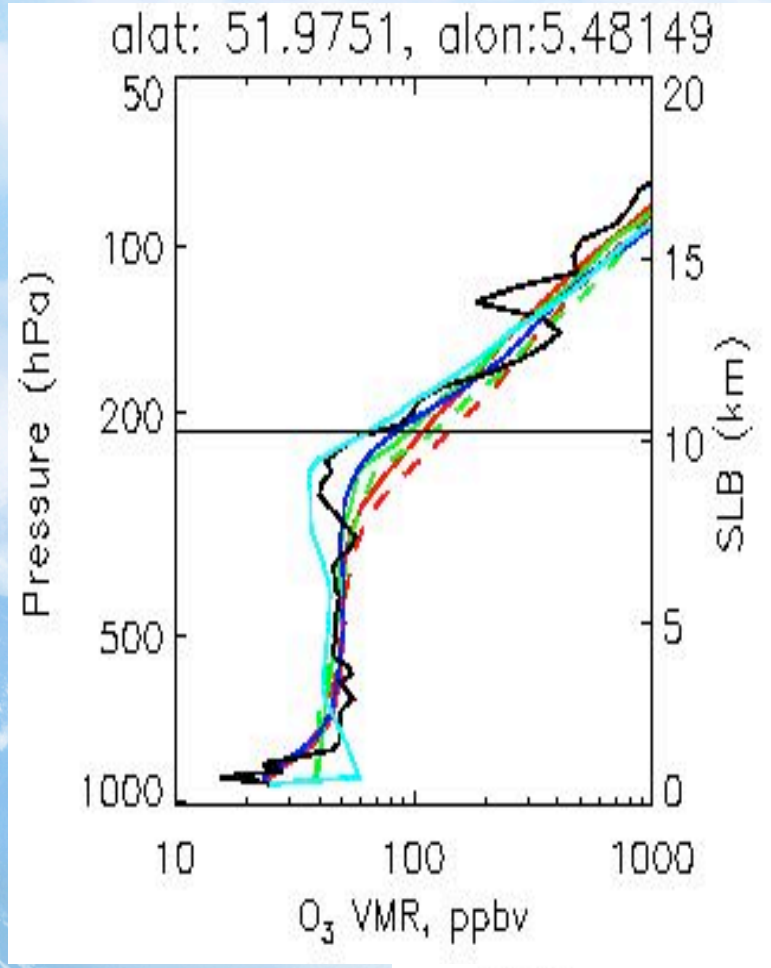
Experiment Setup:

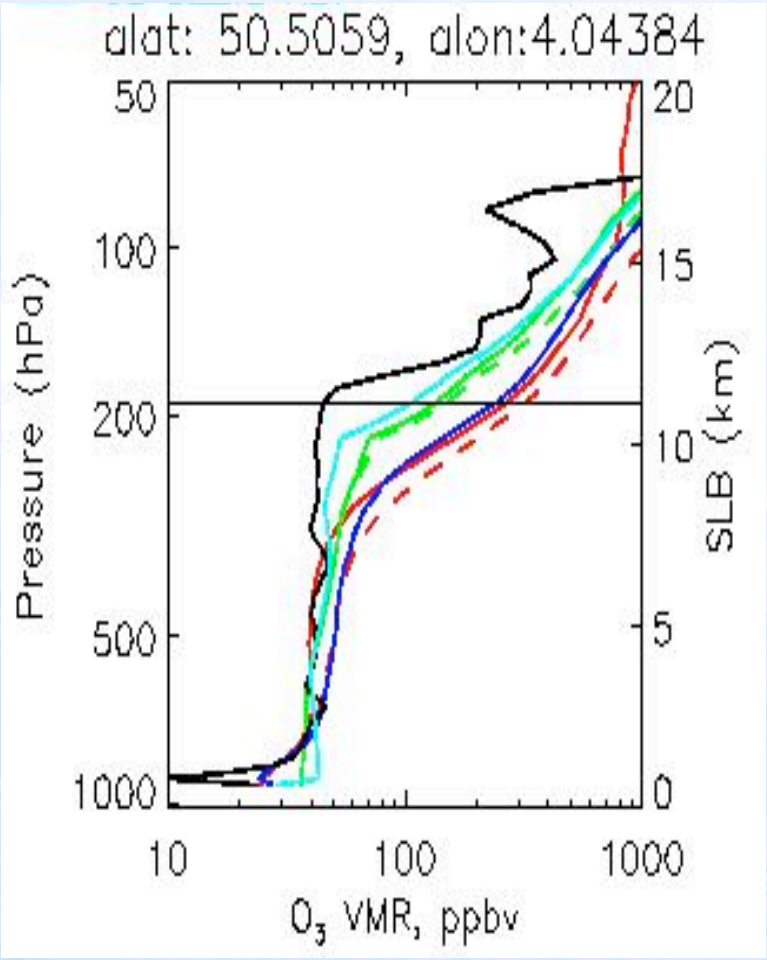
- Case 1: AST algorithm with SLB ozone climatology
- Case 2: AST algorithm with TB ozone climatology
- Case 3: OE algorithm with SLB ozone climatology
- Case 4: OE algorithm with TB ozone climatology

Validation Data

- Ozonesonde dataset (sanity check)
- Simulated ECMWF Focus Day (global): 2007.10.19
- START08 Campaign

Example: Ozone Profile Retrieval





O3snd
A Priori in SLB
AST OZ_SLB RET
OE OZ_SLB RET

A Priori in TB
AST OZ_TB RET
OE OZ_TB RET

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Example: Region

Exp. Using START08 Flight 04: 2008.04.28 "Stratospheric Intrusion"

Horizontal View at 250 hPa

Ozone field (colored)

2, 4 PV (orange contour)

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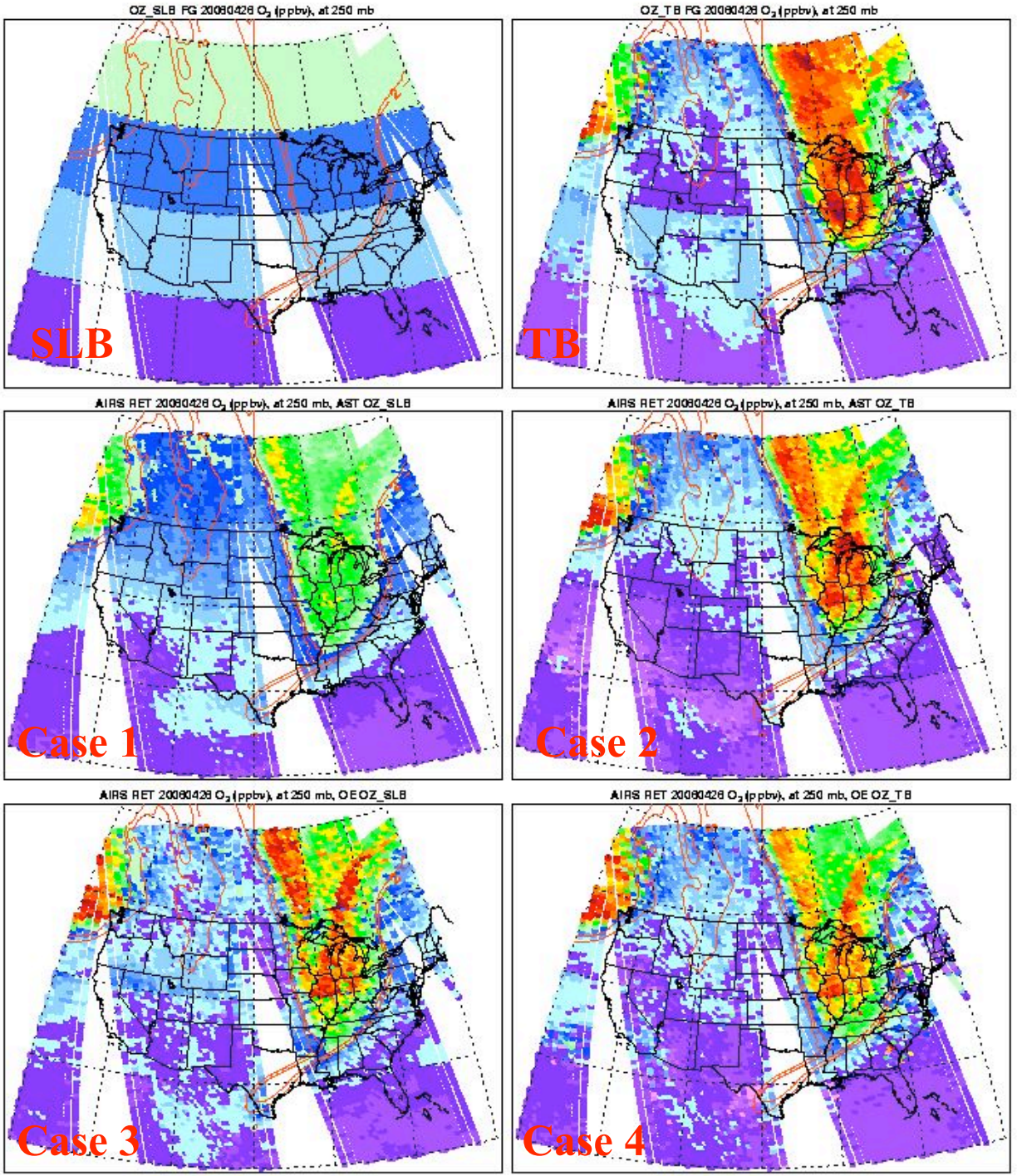
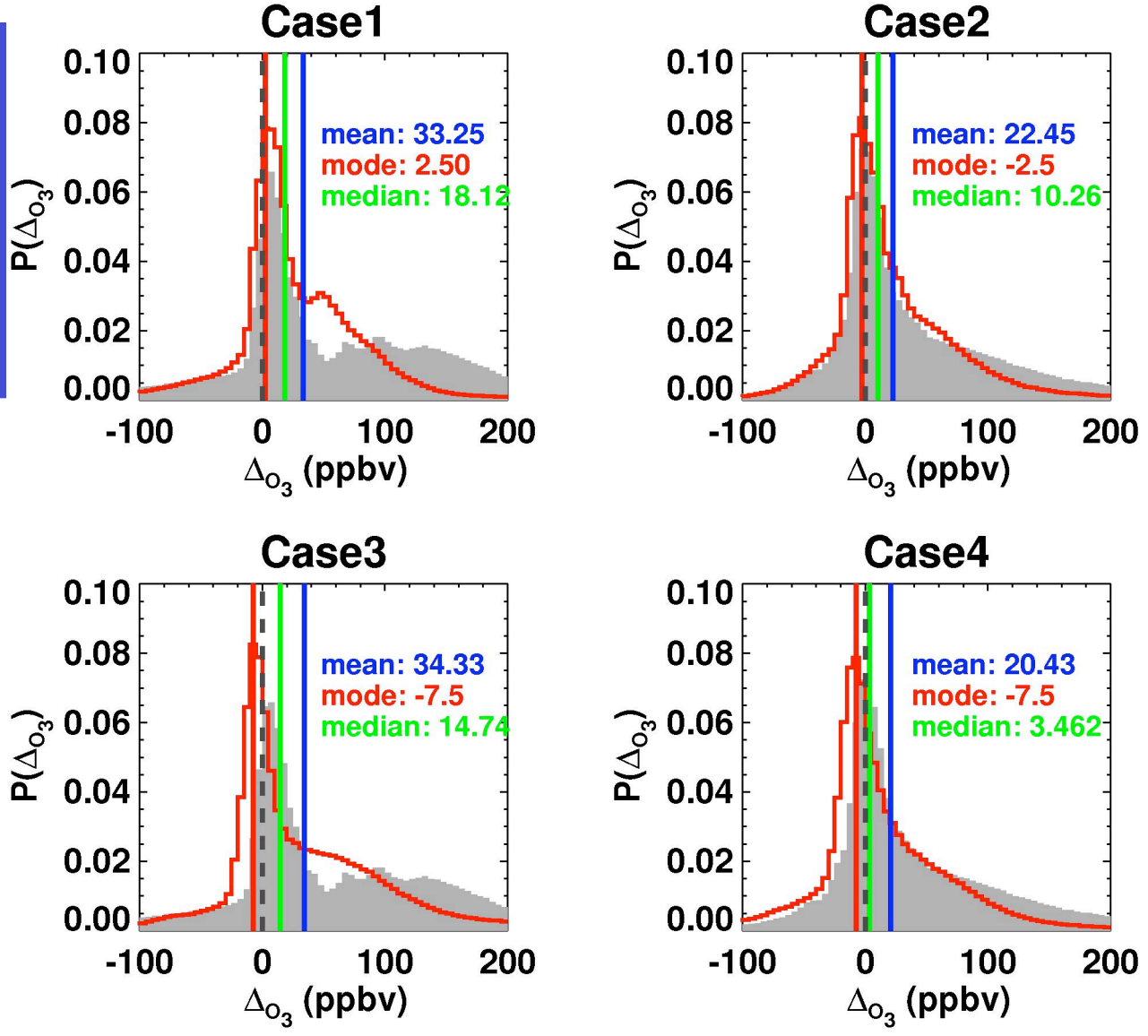


Exp. Using ECMWF 2007.10.19

PDF @ 150 ~ 200 hPa

First Guess: Gray Shaded

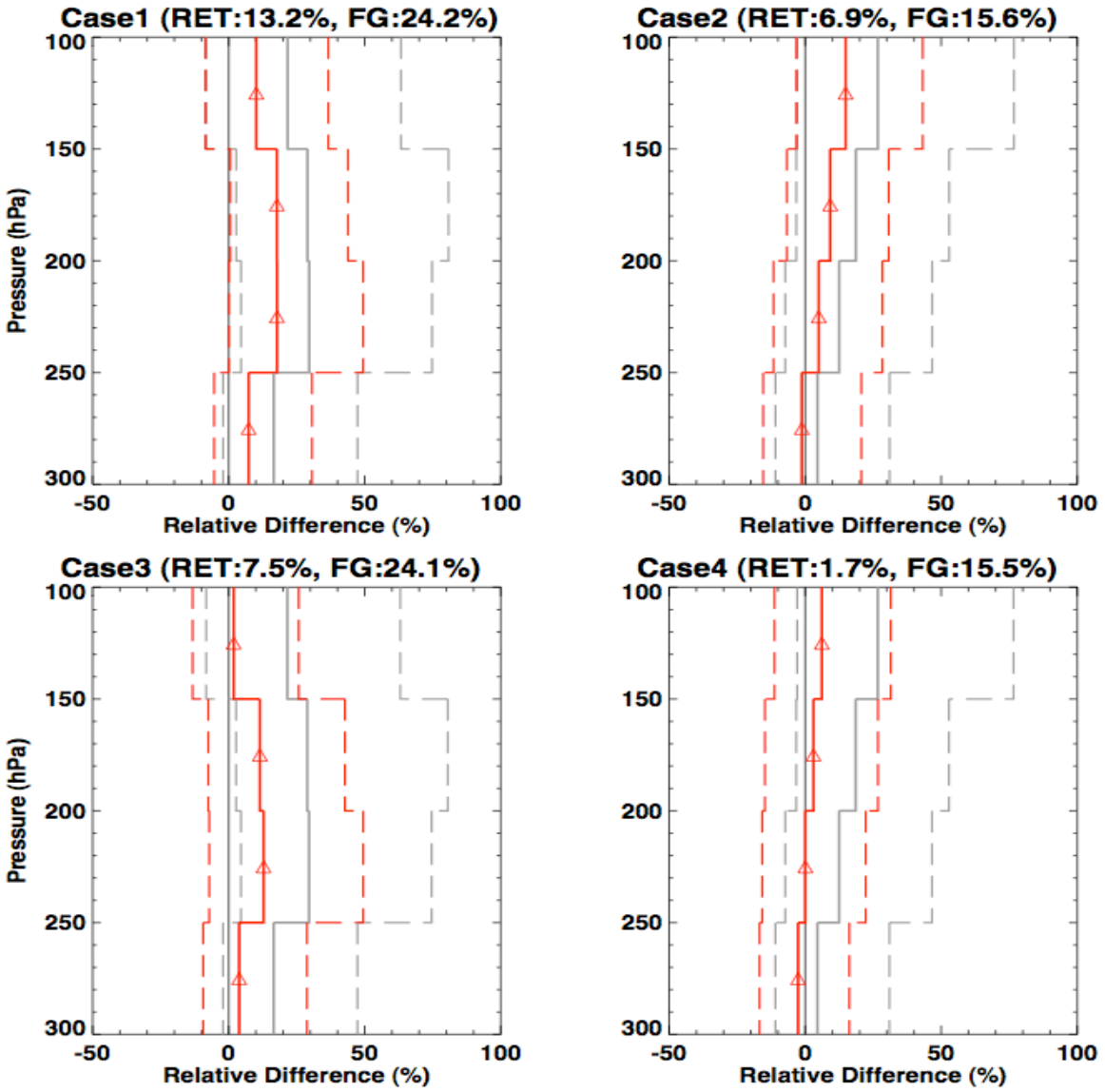
Ret.: Red line



Ensemble Statistics Using ECMWF 2007.10.19

First Guess: Gray line
Ret.: Red line

All lines represent 25% (dashed line), median (solid line), and 75% (dashed line)



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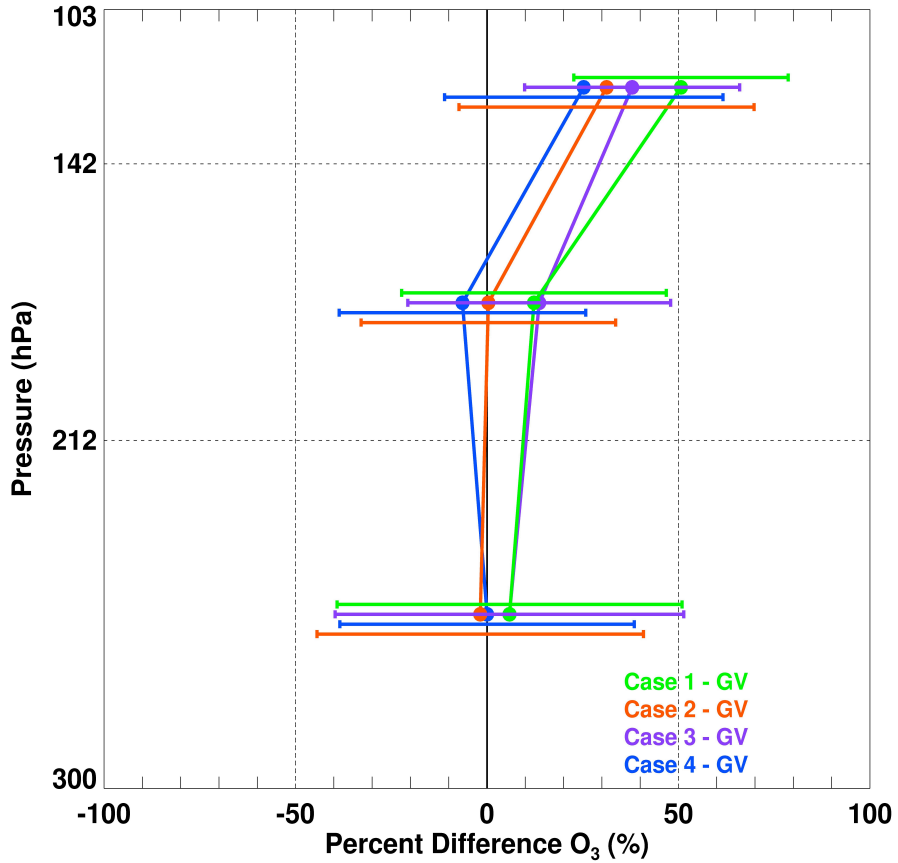
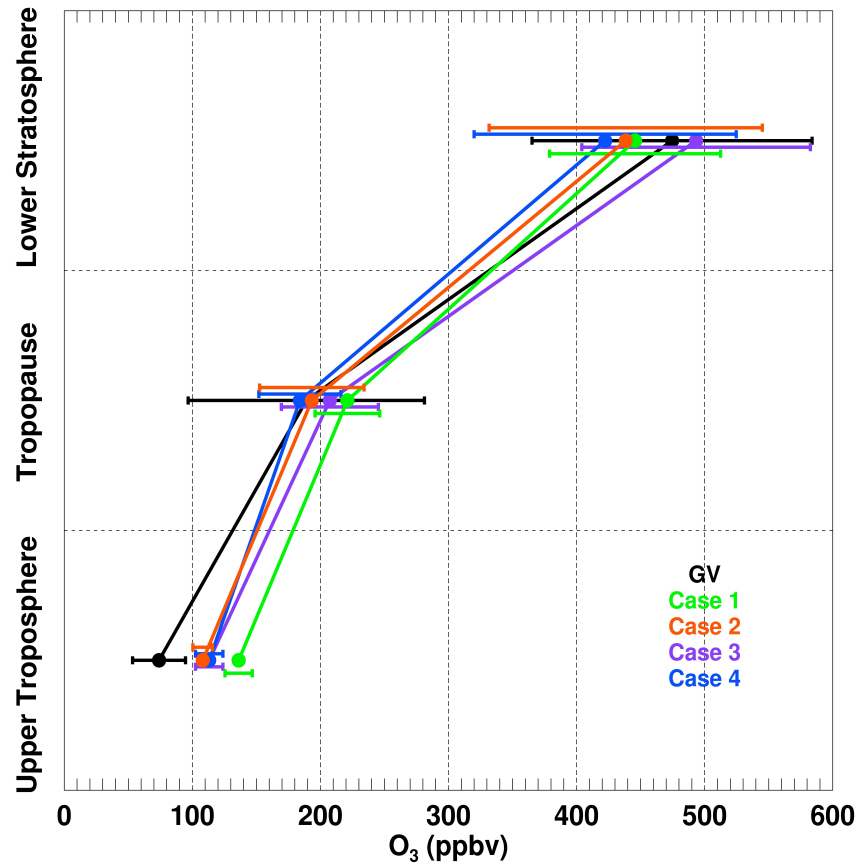
Ensemble Statistics Using START08 GV O3 NOAA





Summary (I)

- Tropopause based ozone climatology in the retrievals captures the strong gradient in ozone retrievals near the tropopause region.
- The OE algorithm with tropopause-based ozone climatology has the best performance in capturing UTLS ozone gradients
- Implication of tropopause based ozone climatology can further improve ozone retrievals in the UTLS region for infrared hyperspectral instruments, such as IASI/CrIS.

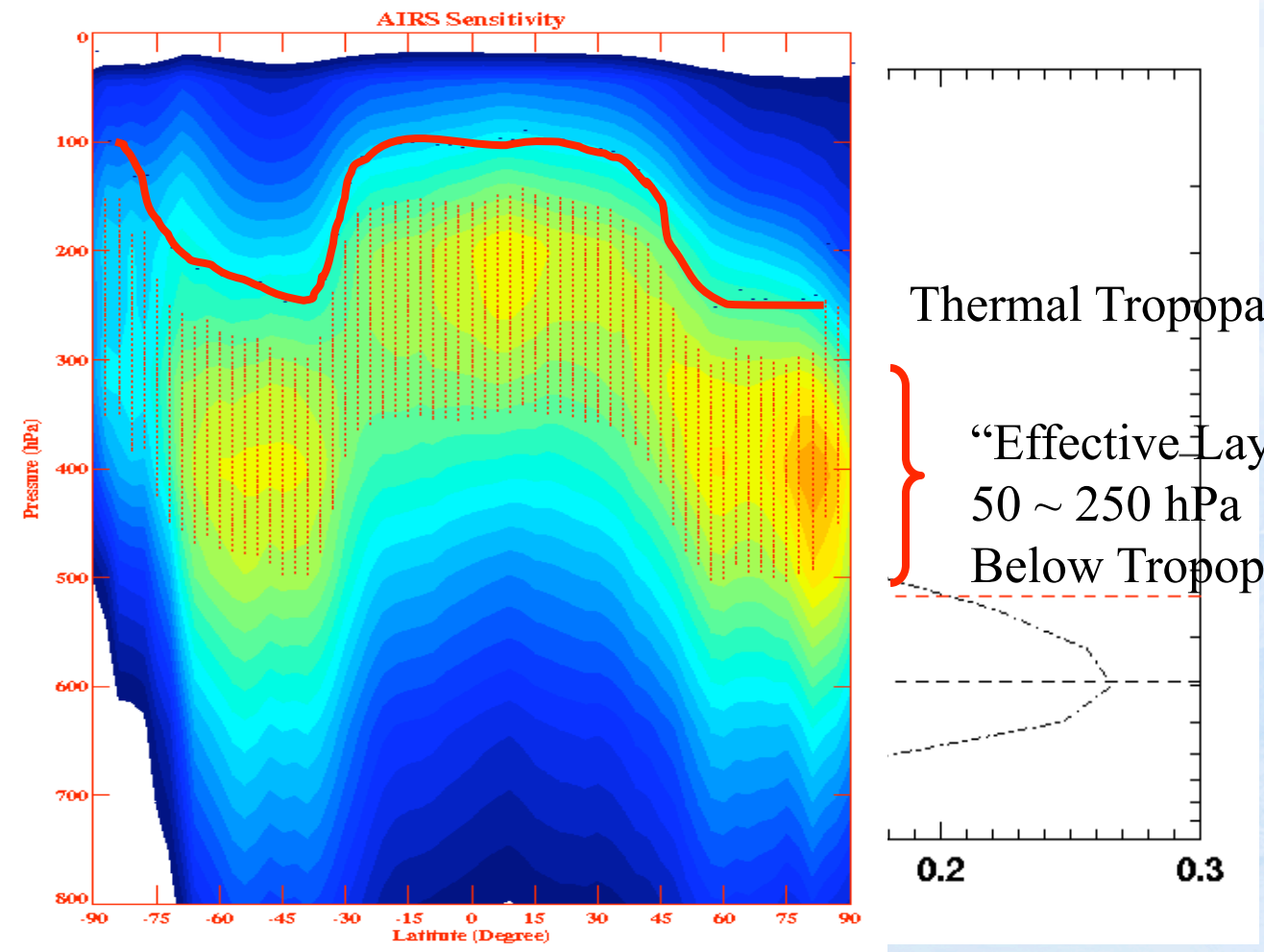
Part (II)

Mid-Upper Tropospheric Methane : Information-Based Analysis and Validation

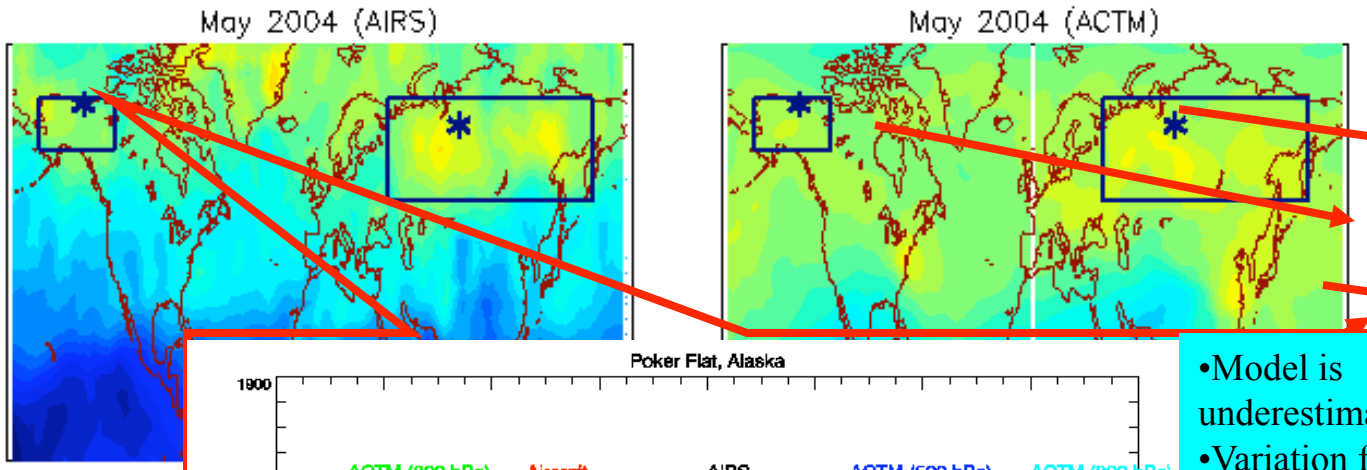
On behalf of Xiaozhen Xiong
(Xiaozhen.Xiong@noaa.gov)

Tropopause vs. Retrieval Max. Sensitive Level

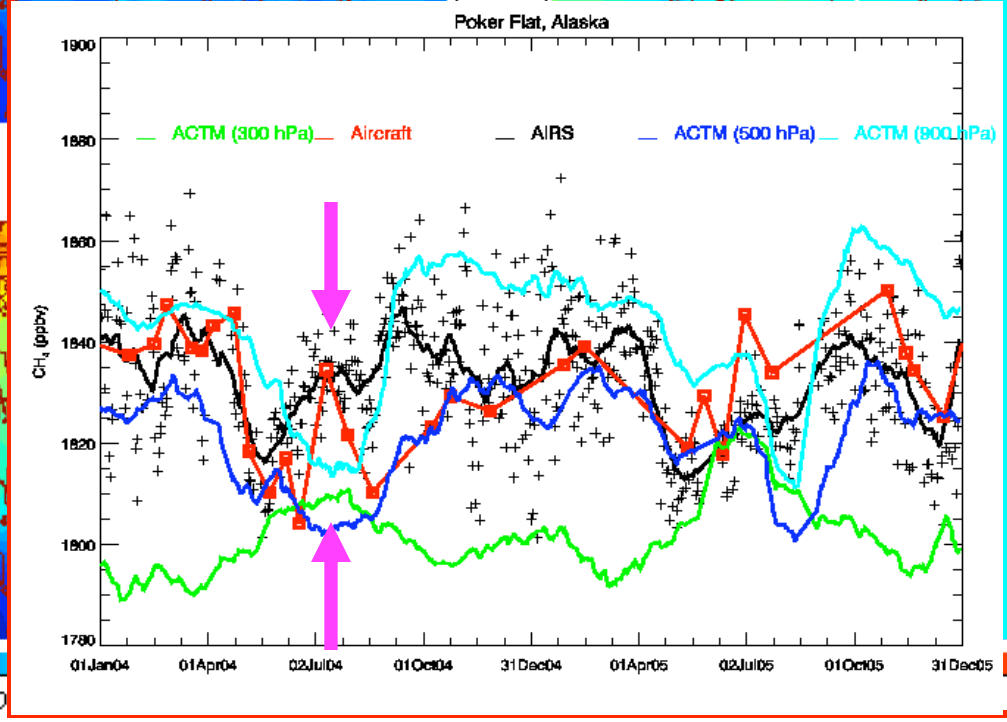
AIRS CH_4
DOF ≈ 1



AIRS Effective Layers vs Model Simulation



Wetland emission increases from May to August



- Model is underestimated
- Variation from model at 300 hPa is out of phase with 900 hPa and 500 hPa
- Small vertical variation in CH_4 in the summer
- Enhancement of CH_4 observed in July '04 from both aircraft and model

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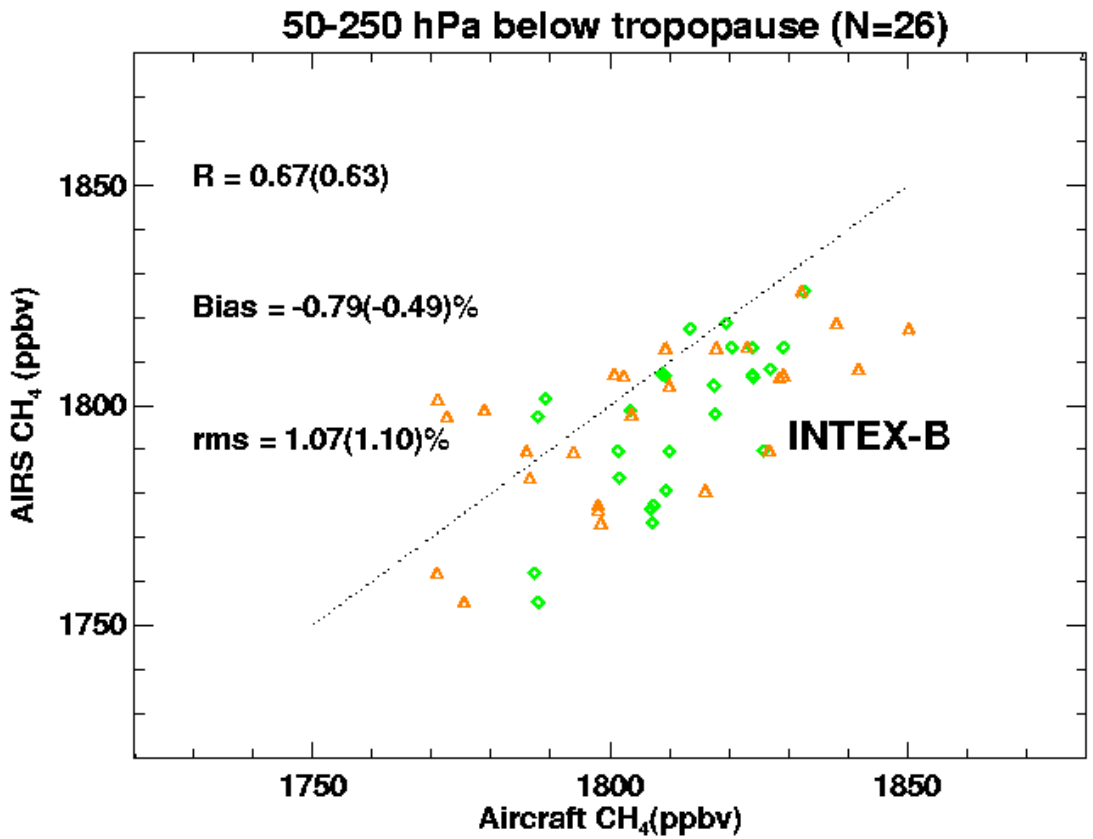
Comparisons with Aircraft Measurements ESRL, INTEX-A, INTEX-B



Δ: Aircraft
◊: Aircraft w/AK

Summary (II)

- Tropopause height correlates well with the max. sensitive layers of methane in the mid-to-high latitudes
- This method is applicable to the aircraft measurements: good agreement in mid-to-upper tropospheric methane and in seasonal variations

Thank You!